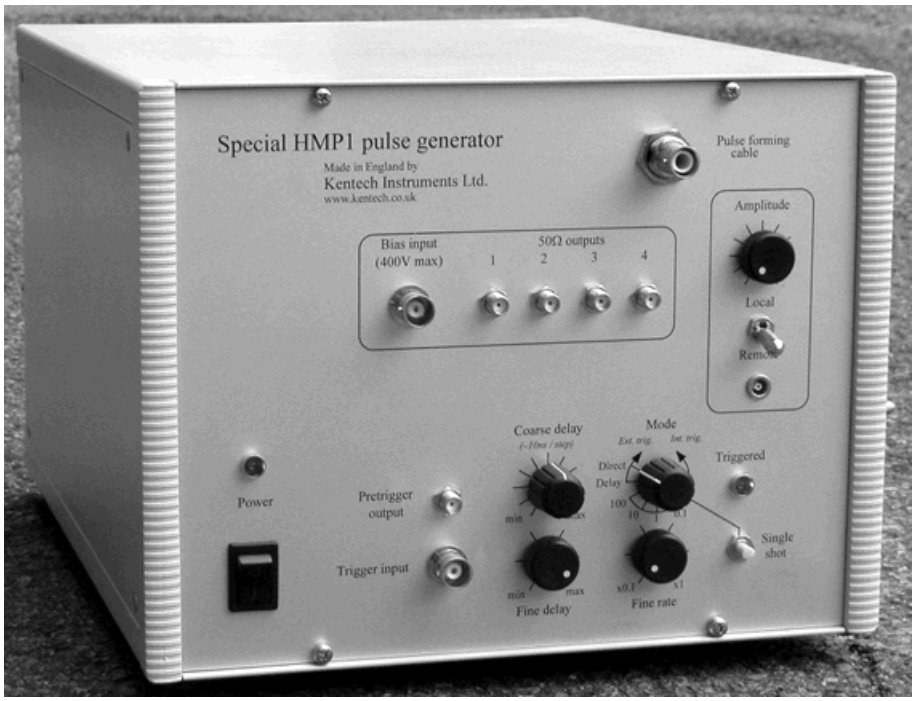
Notes on the use of

Kentech Instruments Ltd.
HMP1/SC/V/N pulser
Serial No. J06*****



4th August 2006

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CAUTION

With an appropriate load, this unit is safe for use by an educated user in a laboratory environment. You are warned however that the radiation from the system with an antenna or inappropriate load attached can damage sensitive equipment and corrupt data stored in computer and microprocessor based systems. It can cause terminal failure of vital medical electronic systems such as pacemakers. This equipment is supplied on the understanding that the user will analyse these risks, accept responsibility for them and take appropriate precautions in the use of this instrument.

The output from this pulse generator will destroy many types of power attenuators and electronic test equipment. It is the users responsibility to ensure that any apparatus connected to the output is suitably rated.

Kentech Instruments Ltd accepts no responsibility for any damage or liabilities incurred in the operation of this equipment.

Please read the manual before applying power.

There are high voltages (4kv) present in this pulser when the unit is operating. Do not remove the covers, return to Kentech Instruments Ltd or its appointed agent for servicing.

The accessible terminals of this instrument are protected from hazardous voltages by basic insulation and protective grounding via the IEC power input connector. It is essential that the ground terminal of this connector is earthed via the power lead to maintain this protection.

If cleaning is necessary this should be performed with a soft dry cloth or tissue only.

RF emissions and EC directive 89/336/EEC

This equipment is a research tool that has been intentionally designed to generate short high energy electromagnetic pulses and the EM emissions will be highly sensitive to the load applied by the user, for example the radiation just from some types of output cable may exceed EC permitted levels.

The level of RF radiation generated by the circuit boards within the instrument is inevitably high but the emissions are largely contained by the instrument enclosure. It is therefore very important that all fasteners are securely fastened, do not operate the pulser with the covers removed. The pulser may still interfere with sensitive equipment at short range.

We believe that with this type of unit it has to be the system builders responsibility to verify that his pulser/load system complies with the EC directive unless the system is used in a screened electromagnetic environment.

We are not able to guarantee compliance with arbitrary loads but to minimise emissions we recommend:-

1) that any load is fully contained within a conductive metal screened box, with all joint surfaces gasketed or fitted with conductive fasteners at less than 5cm intervals.

2) that the load is connected to the pulser output with semi-rigid cable, the cable outer must be carefully connected to the N type output connector at one end, and must be connected directly to the screened box containing the load at the point of entry. Flexible cables should only be used with caution, in particular RG303 type cable will need additional screening to control emissions.

Introduction

Our range of solid state pulsers (ASG, SPS, HMPS and PBG series) allows very high voltage, fast rising pulses to be obtained from compact bench top units. Voltage pulses as short as 100ps FWHM, in excess of 4kV peak voltage into 50Ω, and with a pulse repetition frequency (PRF) >1kHz can be produced. The performance of our compact, convenient and reliable pulsers is to our knowledge exceeded only by laser driven photoconductive switches in terms of voltage switching speeds. These pulsers will find applications in many fields such as high speed camera research, electro-optic switching, triggering systems and radar.

A large range of output pulse lengths can be provided by the incorporation of internal passive pulse forming networks. There is very little jitter in the output of the pulsers and two independent pulsers can be used in parallel to drive low impedances. This aspect makes the pulsers particularly useful for driving microchannel plate systems. Transformers with output impedances as low as 5Ω are available.

The standard drivers and speed-up modules have a life of $>10^{10}$ pulses and have a PRF of ≥1000Hz, although special units with a PRF >50kHz can be supplied. The high repetition rates allow sampling oscilloscopes to be used to characterise a system and verify the pulse shape.

The pulsers can feed into a short circuit load without damage. This allows them to be used in sub-nanosecond pulse chopping systems by feeding through a pockels cell into a shorting stub. Variations on the standard driver are available.

Use

The pulser requires A.C. power and a trigger signal to operate. The trigger signal applied to the front panel trigger input (BNC) should be TTL level into 50Ω with a fast rising edge (<5ns) to maintain the low jitter of the system. When triggered the triggered light on the front panel will flash.

The outputs of the unit are four identical negative square pulses having a maximum amplitude of approximately 600V which appears at the four SMA output front panel connectors. The output pulse width may be changed by means of plug in pulse forming cables pluged into the front panel mounted SHV connector. The pulse width is approximately 1ns when no pulse forming cable is used, with cables supplied to give 2.5, 5 and 10ns. The four 50Ω outputs are connected inside the pulser, so to maintain the wave shape all must be terminated into 50Ω. The output amplitude may be adjusted continuously from 600V down to approximately 360V by means of a front mounted potentiometer or an analogue input voltage to a front panel Lemo connector. Selection of this mode is by means of a locking toggle switch. The analog input has a gain of approximately x100.

The output may have a dc bias superimposed on it. Up to 400V may be applied to the BNC connector on the front panel.

A pretrigger output is available which has fixed timing to the input trigger and before any internal delay settings.

In the internal trigger, single shot and "delayed" modes there is an internal delay which may be adjusted by the user. There are coarse (10ns per step) and fine (~12ns full scale) delay controls. In "direct" mode the trigger is applied directly to the avalanche stack and the low level circuitry is bypassed. In this mode the trigger delay is at a minimum of ~25ns. There is no pretrigger output in this mode.

If it is necessary to monitor or characterise the pulse output then suitable attenuators should be used.

Caution

The output of this unit will damage or destroy many types of high voltage and high power attenuators. We recommend the use of a high voltage, high speed attenuator manufactured by Barth™ as the first in a series. Consult the attenuator manufacturer before using any other configuration.

The output may be observed with a high bandwidth oscilloscope. This may either be a fast (>3GHz) direct access type or a sampling type.
The jitter is ~30ps RMS with a suitably reproducible and fast rising trigger signal.
There are thermal drifts in the delay generator which will stabilise after the pulser has been switched on for ~20 minutes.

Lifetime

Solid state high voltage avalanche pulsers have a long but finite lifetime, generally characterised by the integrated number of output pulses. Fast risetime and high voltage lead to high electrical stress and such processes as partial discharges and other minor breakdown effects can gradually degrade insulation and reduce the lifetime.
With this in mind we recommend that pulsers are not operated unnecessarily and that arrangements are made to remove the trigger pulses when the pulse output is not required. This is most important when pulsers are operated near their maximum repetition frequency.

SPECIFICATIONS

General:

Outputs:	4 negative 50Ω outputs in parallel.
Output voltage	360V to 600V into 50Ω from each output.
Amplitude adjustment:	Amplitude adjustable by front panel potentiometer when the local/remote switch is in local, and by external 3.6 to 6.0V input when in remote.
Output polarity	Negative.
Pulse shape	Square.
Pulse width	1ns FWHM with no pulse forming cable plugged in, 2.5ns, 5ns and 10ns with cables supplied.
Rise time	200ps.
Flatness	</= +/- 10% of nominal amplitude.
Post pulse noise	</= +/- 25% of amplitude for time equal to pulse width.
Output bias	External voltage input up to 400V.
Trigger	TTL into 50Ω, less than 5ns rise.
Jitter	<30ps RMS
Trigger delay	Approximately 25ns in direct mode (from trigger input to outputs).
Repetition rates	≥100Hz
Power supply	100-240V AC 50-60Hz Maximum power <25W

Outputs:

Pretrigger output:	SMA	8V into 50Ω. Leads main output by the delay when delay is active.
Pulse outputs:	4 x SMA	<360 to >600V into 50Ω.

Inputs:

Trigger input:	BNC	TTL into 50Ω, less than 5ns rise.
Output bias input:	BNC	+/- 400V maximum. (470Ω series resistor).
Remote amplitude:	LEMO	3.5 to 6.0V to adjust amplitude with local/remote switch in remote. Connector: - LEMO ERN00250CTL with centre contact positive input voltage. The output pulse amplitude is approximately x100 of the remote input voltage. e.g. 3.6V input gives approximately 360V and 6V input gives approximately 600V output pulse. The input can be 0V to 10 without damage.
Power:	IEC	Power input and fuse on rear panel.

Controls:

Pulse width	SHV	Pulse forming cables. 2.5ns, 5ns and 10ns cables supplied.
Local/Remote:	Locking type toggle switch to select internal or external amplitude setting. Switch arm must be pulled out to allow switch to be changed. This will prevent accidental changing of position	
Amplitude	Single turn front panel mounted potentiometer sets output amplitude when local/remote switch in local.	
Coarse rate/mode:	Sets one of the following modes: Single shot (delay active) 0.01-0.1 Hz (delay active) 0.1-1 Hz (delay active) 1-10 Hz (delay active) 10-100Hz (delay active) External trigger "delay" (delay active) External trigger "direct" (delay inactive)	
Fine rate:	Single turn potentiometer varies internal rate by ratio of 10:1.	
Coarse delay:	Sets internal delay in steps of 10ns up to 100ns.	
Fine delay:	Single turn potentiometer sets internal delay up to 12ns.	
Single shot:	Depressing this button causes a single trigger.	
Power	Switches AC power in the pulser.	

Indicators:

Power	Shows that AC power is applied and the unit is switched on.
Triggered	Illuminates while the unit is being triggered.

Environmental:

Dimensions:	H = 177, H+feet = 187, W = 235mm, D = 305mm.
Weight:	Pulser: 4.1kg.
Ambient temperature	5 to 35°C
Humidity	< 95% non-condensing
Altitude	< 3000m

Declaration of Conformity

We:- **Kentech Instruments Ltd**
Unit 9, Hall Farm Workshops
South Moreton
Didcot
Oxon OX11 9AG, UK

Certify that this apparatus:-

Kentech HMP1/SC/V/N Pulse Generator
serial no. J06*** only.**

Conforms with the protection requirements of European Community Directives:-

73/23/EEC	**Low Voltage Directive**
89/336/EEC	**Electromagnetic Compatibility Directive**
93/68/EEC	**CE Marking Directive**

The following harmonized standards have been applied:-

BS EN55011 Emissions Specification (Group 2 Class A)
Industrial, Scientific and Medical equipment

BS EN50082-2 Generic Immunity Standard
Part 2 Industrial

BS EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

The following documents contain additional relevant information:-

Kentech file reference J06***

Name: P.F.Rouse **Signature:**
On behalf of Kentech Instruments Ltd

Position: Engineer **Issued:** 4th August 2006